REMARKS

Claims 11-31 will be pending upon entry of the present amendment. Claims 1-10 were previously canceled and claim 29 is being canceled. Claims 11, 14-16, and 25-26 are being amended. Claims 32-41 are new.

No new matter is being added. The claims are being amended primarily to further define the first and second bases. Support for the amended language can be found throughout the original specification, but particular attention can be paid to page 24 for the amendments to independent claims 11, 14-15, and 26; page 8, line 17 – page 9, line 9 and page 12, lines 11-15 for new independent claim 32; and page 4, lines 4-17, page 7, lines 11-18, and claim 1 for new independent claim 37.

Claims 11-15 and 25-31 were rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 6,378,104 to Okita in view of 6,233,717 to Choi.

Okita and Choi do not teach or suggest the invention recited in claim 11. Claim 11 recites an error control method that includes converting a first information word, having input symbols in a first base, into a second base by converting the input symbols into input symbols in the second base. For example, one embodiment in the specification describes converting symbols from base 4 (quaternary) to base 16 (hexadecimal).

The applicants disagree with the Examiner's response to the applicants' remarks in the amendment filed on December 15, 2004, explaining why Okita and Choi do not convert input symbols from a first base into a second base. The Examiner responded that Okita teaches transforming a Reed-Solomon code RS_a, RS_b, … RS_x associated with respective Galois fields GF_a, GF_a, … $GF_a$with respective bases a, b, … x to any other Reed-Solomon code. Further, the Examiner asserted that the consecutive powers of α in GF_a form a "basis" for the Galois field GF_a and consecutive powers of β form a basis for the Galois field GF_b. A person of ordinary skill in the art would not consider either the subscripts a, b, and x of the Reed-Solomon codes or the consecutive powers of α or β as first and second bases or symbols in first and second bases. The subscripts a, b, and x are merely identifiers or labels that distinguish one Reed-Solomon code from another. The α and β are roots of respective field generation polynomials $Gp_a(x)$ and $Gp_b(x)$ (see col. 5, lines 51-61).

It is important to recognize that, instead of converting an information word between first and second bases, Okita is directed to using different field generation polynomials $Gp_a(x)$ and $Gp_b(x)$ that generate different Galois fields $GF_a(2^m)$ and $GF_b(2^m)$ (See Figs. 11-16 and accompanying discussion). The value 2^m (or 2^8 in the preferred embodiment) represents the cardinality or number of elements of the Galois fields. Such elements typically are represented by symbols of base 2^m. It will be appreciated that the cardinality of the Galois fields in Okita remains 2^m regardless of the generator polynomials used.

To clarify the distinctions between the invention and the cited prior art, the independent claims are being amended to more precisely recite the symbols in the first and second bases. In particular, amended claim 11 recites that the first base is equal to the number of storage levels at which the memory cells are operating and the second base is equal to a maximum number of storage levels of the memory cells. The subscripts a, b, and x and the roots α and β of Okita are unrelated to the number of storage levels at which the memory cells are operating and the maximum number of storage levels of the memory cells. Thus, Okita and Choi do not teach or suggest "converting a first information word, having input symbols in a first base, into a second base by converting the input symbols into input symbols in the second base" where the first and second bases respectively equal the number of storage levels at which the memory cells are operating and the maximum number of storage levels of the memory cells.

For the foregoing reasons, amended claim 11 is nonobvious in view of the cited prior art. Claims 12-13 and 25 depend on claim 11, and thus, are also nonobvious.

Although the language of claims 14-15, 26-28, and 30-31 differs from that of claims 11-13 and 25, the allowability of claims 14-15, 26-28, and 30-31 will be apparent in view of the above discussion.

Okita and Choi also do not teach or suggest the invention recited in new claims 32-36. Claim 32 recites an error control method that includes converting a first information word from a first base of b-ary elements into a second base of b^s-ary elements by converting the input symbols into input symbols in the second base. For example, one embodiment in the specification describes converting symbols from a first base of 4 elements (b=4) to a second base of 16 elements (b^s= 16, b=4, s=2).

Okita and Choi do not teach or suggest such converting of a first information word from a b-ary first base to a b^s-ary second base. First, as mentioned above, a person of ordinary skill in the art would not interpret the identifiers a, b, and c and the roots α and β as being bases. Second, Okita does not teach or suggest that the roots α and β have a relationship of b to b^s. That is, raising α to a power s does not equal β and vice-versa. Accordingly, new claims 32-36 are nonobvious in view of the cited prior art.

Okita and Choi also do not teach or suggest the invention recited in new claims 37-41. Claim 37 recites an error control method that includes converting the first information word into a second base by converting the input symbols into input symbols in the second base. The first base is defined by a first alphabet having a first number of symbols and the second base being defined by a second alphabet having a second number of symbols, the second number being different than the first number. Again referring to one of the examples described in the specification, a quaternary number (that is, a base 4 number defined by an alphabet of 4 symbols: 0, 1, 2, 3) is converted to a hexadecimal number (that is, a base 16 number defined by an alphabet of 16 symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, E, F).

Okita and Choi do not teach or suggest such converting of an information between first and second bases defined respectively by a first alphabet having a first number of symbols and a second alphabet having a second number of symbols. Again, the identifiers a, b, and c and the roots α and β of Okita are not first and second bases. In addition, the identifiers a, b, and c and the roots α and β are not defined by first and second alphabets having first and second numbers of symbols. Instead, Okita reports that his codes are 2^8-ary codes, i.e. codes over the Galois field GF (2^8) (i.e. a finite field with $2^8 = 256$ elements, where each element can be represented by a single-digit number in base 256) (col. 1, lines 36-65).

For the foregoing reasons, claims 37-41 are nonobvious in view of the cited prior art.

Claims 16-24 were rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement because the Examiner asserts that claim 11 recites "an error control method," claims 16-24 recite steps for designing an error control code, and the specification does not teach the steps of claims 16-24 as part of an error control method.

The applicants respectfully disagree with the Examiner's enablement assertions. One of the steps of the error control method of claim 11 is "encoding the converted first information word into a first codeword having k+n coded symbols in the second base." The specification and claim 16 specify that, in one embodiment, the encoding step multiplies the information word by a generating matrix (see, e.g., p. 7, line 11 – p. 8, line 16; p. 15, line 14 – p. 17, line 18; original claim 1). The specification explains in great detail many steps for producing the generating matrix in various embodiments (see, e.g., p. 8, line 17 – p. 11, line 8; pages 19-23; and original claim 1). Since the encoding step of the error control method uses a generating matrix in the embodiment recited in claim 16, the steps of producing the generating matrix are inherently part of the encoding step of the error control method.

The Examiner responded to the applicants' remarks on enablement by incorrectly asserting that the applicants' disclosure explicitly teaches that the steps in claim 16 are not directed toward an error control method. To the contrary, page 6, lines 23-24 states, "Figure 6 shows a flowchart of the **operations according to the construction of an error-control method** according to the present invention.

The applicants respectfully disagree with the Examiner's implication that using a single error correction code means that the method steps of claims 16-24 are not part of an error control method. Nothing in section 112 or logically requires an error correction code to be produced repeatedly in order for the steps of production to be considered as part of an encoding step that uses the generating matrix. In other words, the encoding step can create a generating matrix once and use it many times to create codewords without creating any enablement problems. The applicants respectfully submit that the Examiner is creating an artificial distinction between creating and using an error correction code that is not required by logic or the law.

For the foregoing reasons, claims 16-24 are supported by an enabling disclosure.

In addition, claims 16-24 were rejected under 35 U.S.C. § 112, second paragraph, as being incomplete for failing to define cooperative relationships between the steps of claims 16-24 and the steps of claim 11.

The applicants respectfully disagree. One of the steps of the error control method of claim 11 is "encoding the converted first information word into a first codeword having k+n coded symbols in the second base." Claim 16 further defines the encoding step by reciting that "the encoding step includes generating the first codeword through an operation of multiplication between the first information word and a generating matrix." Claim 16 further recites sub-steps of the encoding step that are used to determine the generating matrix. Thus, claim 16 specifically defines the cooperative relationships between the steps of claim 16 and the encoding step of the error control method of claim 11.

For the foregoing reasons, amended claims 16-24 particularly point out and distinctly claim the invention.

The Director is authorized to charge any additional fees due by way of this Amendment, or credit any overpayment, to our Deposit Account No. 19-1090.

All of the claims remaining in the application are now clearly allowable. Favorable consideration and a Notice of Allowance are earnestly solicited.

Respectfully submitted,

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